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PENSOFT

First record of *Gypogyna forceps* Simon, 1900 (Araneae, Salticidae, Scopocirini) in Uruguay, with notes on its taxonomy and natural history

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Abstract

We present the first record of *Gypogyna forceps* Simon, 1900 from Uruguay. This also constitutes the first record of tribe Scopocirini from the country, as well as being the southernmost record for the tribe and species. We provide new data and comments on its taxonomy, including the first description and images of internal female genitalia, as well as an updated distribution and notes on its natural history. Photographs of living and preserved specimens are also included.

Keywords

Amycoida, biological corridor, chelicerae, distribution, Neotropics, new records

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Introduction

Salticidae, or jumping spiders are the largest family within order Araneae with 658 genera and 6352 species (World Spider Catalog 2021). It encompasses seven subfamilies, of which Salticinae has the greatest species richness and is distributed all over the world (Maddison 2015). Salticinae is composed of the clades Salticoida and Amycoida, with the latter clade mostly Neotropical in distribution and comprising nine tribes (Ruiz and Maddison 2015; Maddison 2015). Among them, Scopocirini Simon, 1901 is represented by two genera: *Scopocira* Simon, 1900, with 15 species from Central and South America, and the monotypic *Gypogyna* Simon, 1900 (World Spider Catalog 2021).

Gypogyna forceps Simon, 1900 was originally described based on male specimens from Paraguay, although no specific location other than country was given. Simon's description did not provide numerical data aside from total body length, and the only illustrations he subsequently published were of the male prosoma and chelicerae (Simon 1901: figs. 500, 501). Because of this, Galiano (1958) redescribed the species on the basis of male and female specimens from Misiones, Argentina. She also illustrated the male palp and the ventral epigyne for the first time. However, the measurements present in Galiano's description were based on just a single male and female specimen, and therefore do not give much

insight into potential size variation within the species.

Recent records have shown that the species has a wide distribution in South America, ranging from Colombia (Bedoya-Róqueme et al. 2018) to Entre Ríos, Argentina (Pett 2019). Most new distribution records are derived from species checklists (see Höfer and Brescovit 2001; Raizer 2004; Ott et al. 2007; Buckup et al. 2010; da Silva Melo et al. 2012; Rubio et al. 2019; Carvalho 2020) and, as such, have not provided further data on the natural history of the species.

The aim of this study is to report the first record of tribe Scopocirini and the species *Gypogyna forceps* from Uruguay, as well as to provide an updated geographic distribution for the species in South America, considering records from new sources. We present the first images and description of internal female genitalia together with additional taxonomic and natural history data. We also discuss the role of enlarged chelicerae in intraspecific interactions and the potential of the Uruguay River as a biological corridor.

Methods

Specimens were collected in riparian forests from Arroyo Negro, Departamento de Río Negro, Uruguay, using the beating-sheet method during daytime. Some adult spiders were kept alive for observations of behavioral traits. They were housed in plastic petri dishes and given food (*Drosophila melanogaster* Meigen, 1830) and water *ad libitum*. The examined material is deposited in the Colección Aracnológica de Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay (FCE-Ar, curator M. Simó). Measurements were made in millimeters (mm) under a stereoscopic microscope, following Galiano (1958). Photographs of preserved specimens were taken with a Nikon D3500 digital camera attached to a microscope and images were stacked using Helicon Focus v. 7.6.4 Lite software. Female genitalia from one specimen were cleaned in a solution of trypsin for the digestion of soft tissues (Maddison 1996: 220) and then cleared using clove oil (Levi 1965). The length of the embolus is measured according to Bustamante and Ruiz (2017), and the relative position where it arises is expressed following Bustamante and Ruiz (2020). *In vivo* pictures and videos were taken with an Olympus Tough Tg-4 digital camera. The distribution map was created using Simplemappr (Shorthouse 2010) and based on data obtained from literature and the GBIF (2021) and iNaturalist online databases (Souza 2019; Pereira 2020; Virili 2020; Jambrina 2021; Zambolli 2021).

Results

Family Salticidae Blackwall, 1841
Subfamily Salticinae Blackwall, 1841
Clade Amycoida Maddison & Hedin, 2003
Tribe Scopocirini Simon, 1901
Genus *Gypogyna* Simon, 1900

Gypogyna forceps Simon, 1900

New record. URUGUAY – **Río Negro** • Route 24, km 85, Arroyo Negro, Estancia "Las Cadenas"; 32°31′11.80″S, 058′02′10.22″W; 14.I.2021; D. Hagopián and A. Mailhos leg.; riparian forest; beating-sheet method; 2 ♂, 10 ♀, ethanol 70%, FCE-Ar 12842; 2♀, ethanol 95%, FCE-Ar 12843.

Identification. The specimens were identified based on the descriptions made by Simon (1900, 1901) and Galiano (1958, 1963). The coloration and banding pattern in live and preserved specimens match those reported in previous descriptions and associated figures (e.g., Pett 2019: fig. 2) (Figs. 1B–G, 2A, 3A). Elongated, robust, and horizontal male chelicerae (Fig. 1D–G) are diagnostic for *Gypogyna* and represent a striking difference with *Scopocira*, the sister genus. Chelicerae in males of *G. forceps* are further characterized by the presence of three teeth on the promargin: one distal, long and curved forwards, another small tooth in the midsection and a third, even smaller proximal tooth. On the retromargin there is a thick and distinctly hairy apophysis near the base of the fang, and a small tooth slightly above the midsection (Fig. 2D). In addition, male palps in *Gypogyna* have a disciform tegulum and an embolus arising at 9 o'clock, with a path of 540° (1T+180°) before the distal coil, which curves around the retrolateral region of the cymbium (Fig. 4A, B). Moreover, the tibia has a curved RTA, shorter than in *Scopocira*, as well as a flattened and rounded RvTA (Fig. 4A–C). Although there are no current descriptions of female genitalia, the epigyne in the specimens we collected matches the drawing made by Galiano (1958: fig. 3C) (Fig. 4D).

Description of female genitalia. Internal female genitalia exhibit a small and rounded pair of spermathecae placed anteriorly. The copulatory ducts are thick, membranous and convoluted posteriorly, becoming thinner and sclerotized towards the spermathecae, making this last portion visible from a ventral perspective (Fig. 4D, E).

Measurements. Very few measurements have been provided in previous descriptions of *Gypogyna*, which makes it tough to make comparisons in any meaningful way (Table 1). Overall, Galiano's (1958) data tends to fall near the lower value of the ranges presented here, for both males and females. On the other hand, the values presented by Simon (1900) for male body length and Bedoya-Róqueme et al. (2018) for male prosoma and opisthosoma length surpass the upper value of our respective ranges.

Taxonomic remarks. Galiano (1958) observed that the number of teeth on the retromargin of female chelicerae was somewhat variable and stated that some specimens had three, while others had four. In this study we found greater variation for this trait among analyzed specimens: two teeth on the retromargin and five on the

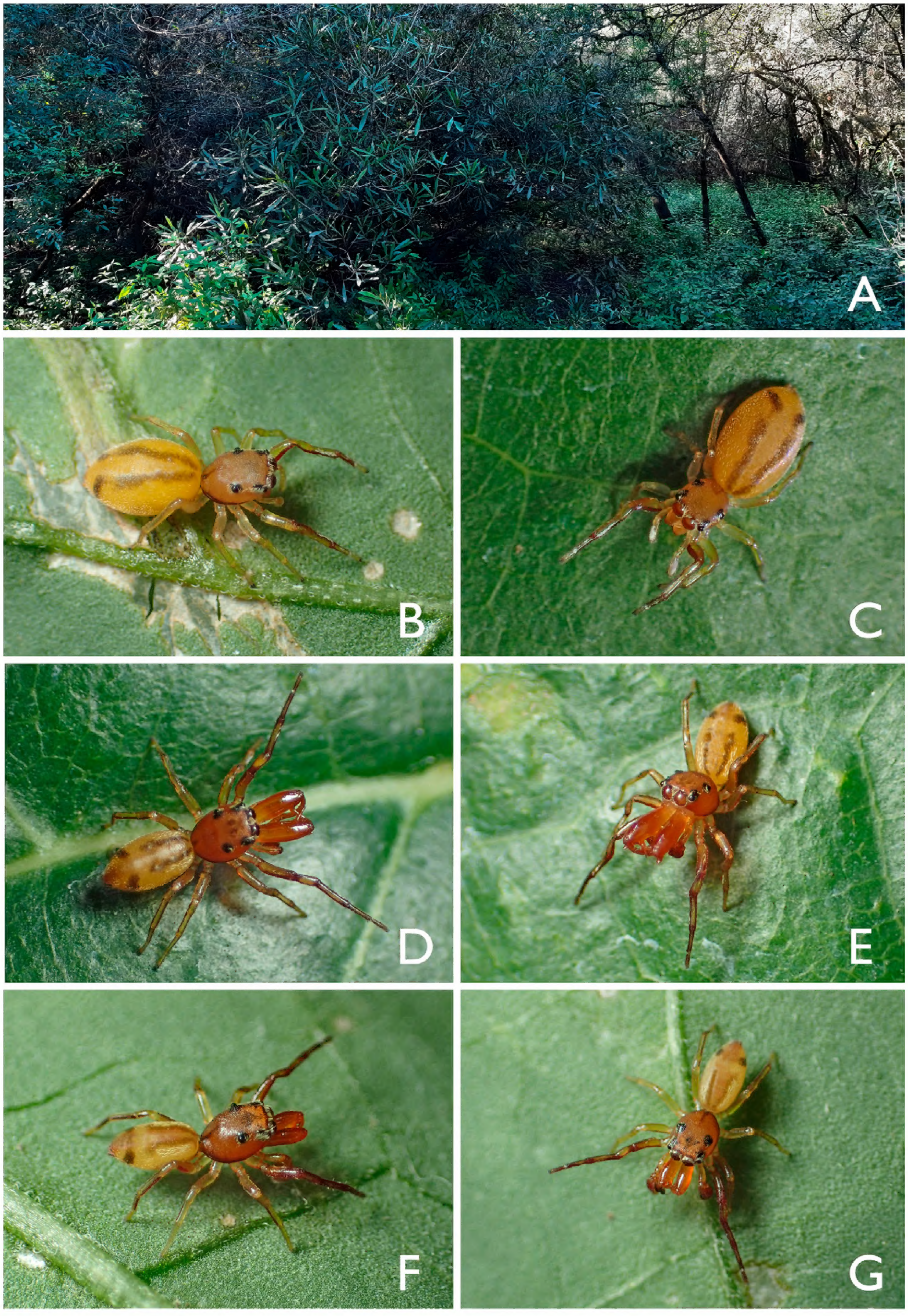

Figure 1. *Gypogyna forceps* and its natural environment. **A.** *Pouteria salicifolia* in a Uruguayan riparian forest, where adults of *G. forceps* were found. **B, C.** Female. **D, E.** Male with long chelicerae. **F, G.** Male with short chelicerae.

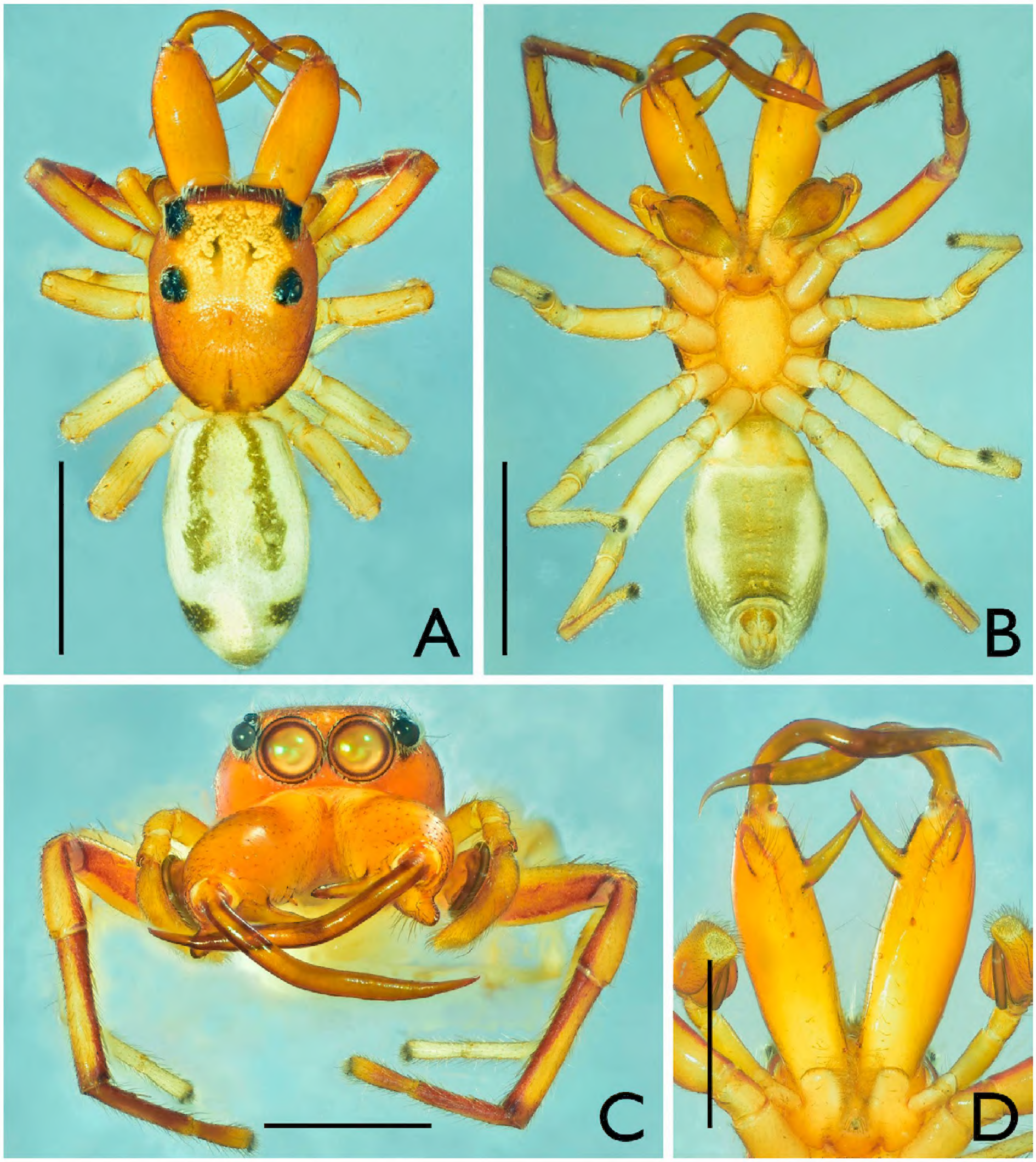

Figure 2. Male of *Gypogyna forceps*. **A.** Dorsal habitus. **B.** Ventral habitus. **C.** Frontal view. **D.** Chelicerae, ventral view. Scale bars: A–C = 1 mm; D = 0.5 mm.

promargin (n = 1); three on the retromargin and five on the promargin (n = 1); three on the retromargin and six on the promargin (n = 7) (Fig. 3D); five teeth on the promargin but two on the retromargin of one chelicera and three on the other (n = 1).

Natural history. Numerous adults and juveniles of *G. forceps* were found on riparian forest vegetation, mainly on *Pouteria salicifolia* (Spreng.) Radlk. (Sapotaceae), a common tree within the forest (Fig. 1A). Adults were found in the summer and juveniles in summer and fall. Other Salticidae abundant in the same location and habitat were *Lyssomanes pauper* Mello-Leitão, 1945, *Cotinusa trifasciata* (Mello-Leitão, 1943) and *Synemosyna aurantiaca* (Mello-Leitão, 1917). Additionally, some juveniles and subadults of *G. forceps* were seen on the shrub *Baccharis trimera* (Less.) DC. (Compositae) and walking along fence wiring in locations up to 1.3 km away from the forest margin, albeit mostly in shaded places. Pett (2019) also reported finding specimens on fences. Individuals were seen to move quickly, continuously waving their first pair of legs (Supplementary file 1). They also exhibited this behavior when they were threatened or capturing their prey.

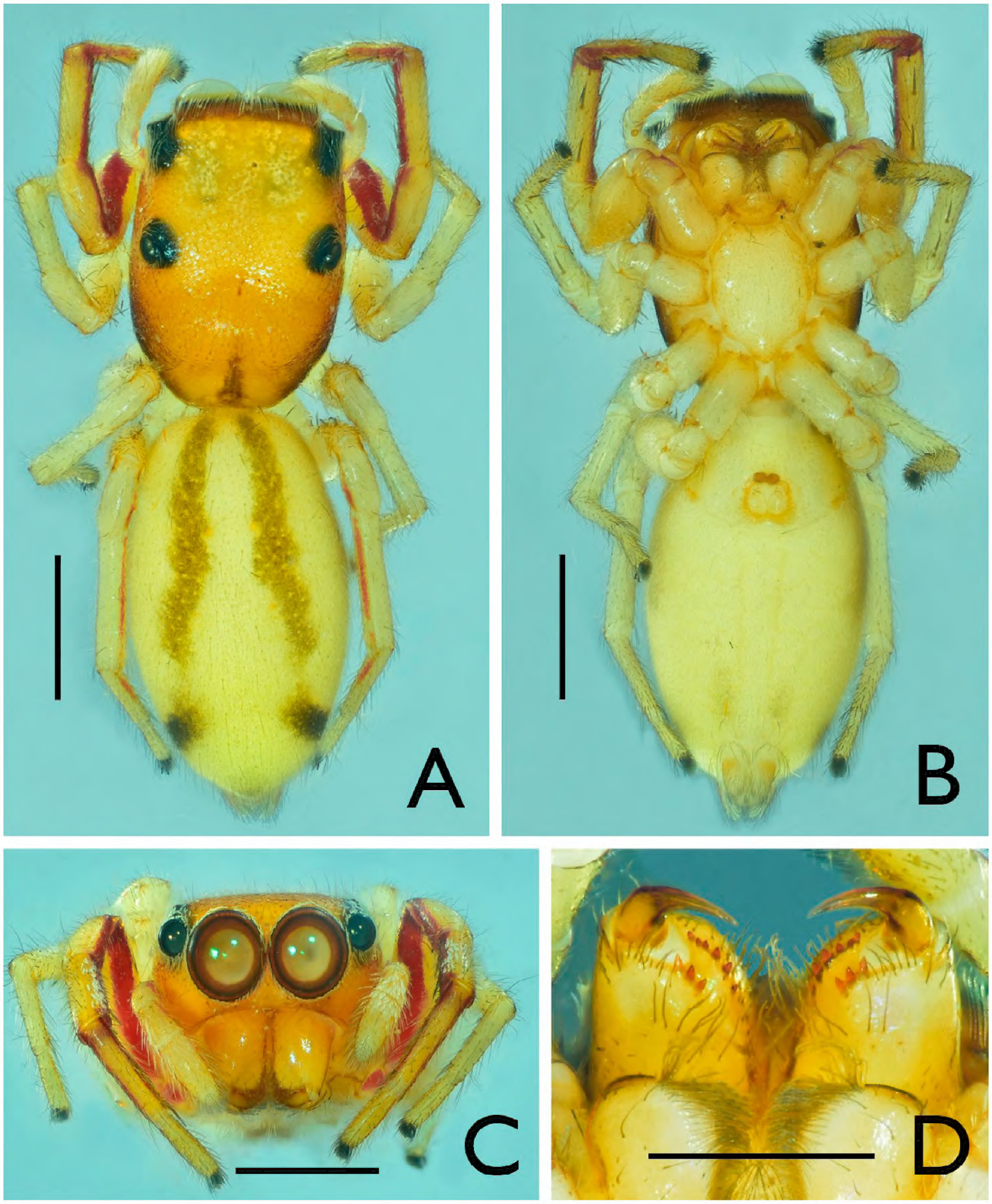

Figure 3. Female of *Gypogyna forceps*. **A.** Dorsal habitus. **B.** Ventral habitus. **C.** Frontal view. **D.** Chelicerae, ventral view. Scale bars: A–C = 1 mm; D = 0.25 mm.

Distribution. Argentina (Chaco, Corrientes, Entre Ríos, Misiones, Santa Fé) (Galiano 1958; Roget 2017; Rubio et al. 2019; Virili 2020; GBIF 2021; Jambrina 2021), Brazil (Amazonas, Bahia, Distrito Federal, Goiás, Mato Grosso do Sul, Minas Gerais, Rio Grande do Sul, São Paulo) (Höfer and Brescovit 2001; Raizer 2004; Ott et al. 2007; Buckup et al. 2010; da Silva Melo et al. 2012; Souza 2019; Carvalho 2020; Pereira 2020; GBIF 2021; Zambolli 2021), Colombia (Córdoba) (Bedoya-Róqueme et al. 2018), Paraguay (Cordillera, Ñeembucú) (Simon 1900; Pett 2019; GBIF 2021), Uruguay (Río Negro) (Fig. 5).

Discussion

We present the first record of *Gypogyna forceps*, and thus tribe Scopocirini, from Uruguay, raising the total number of Salticidae tribes known from the country to

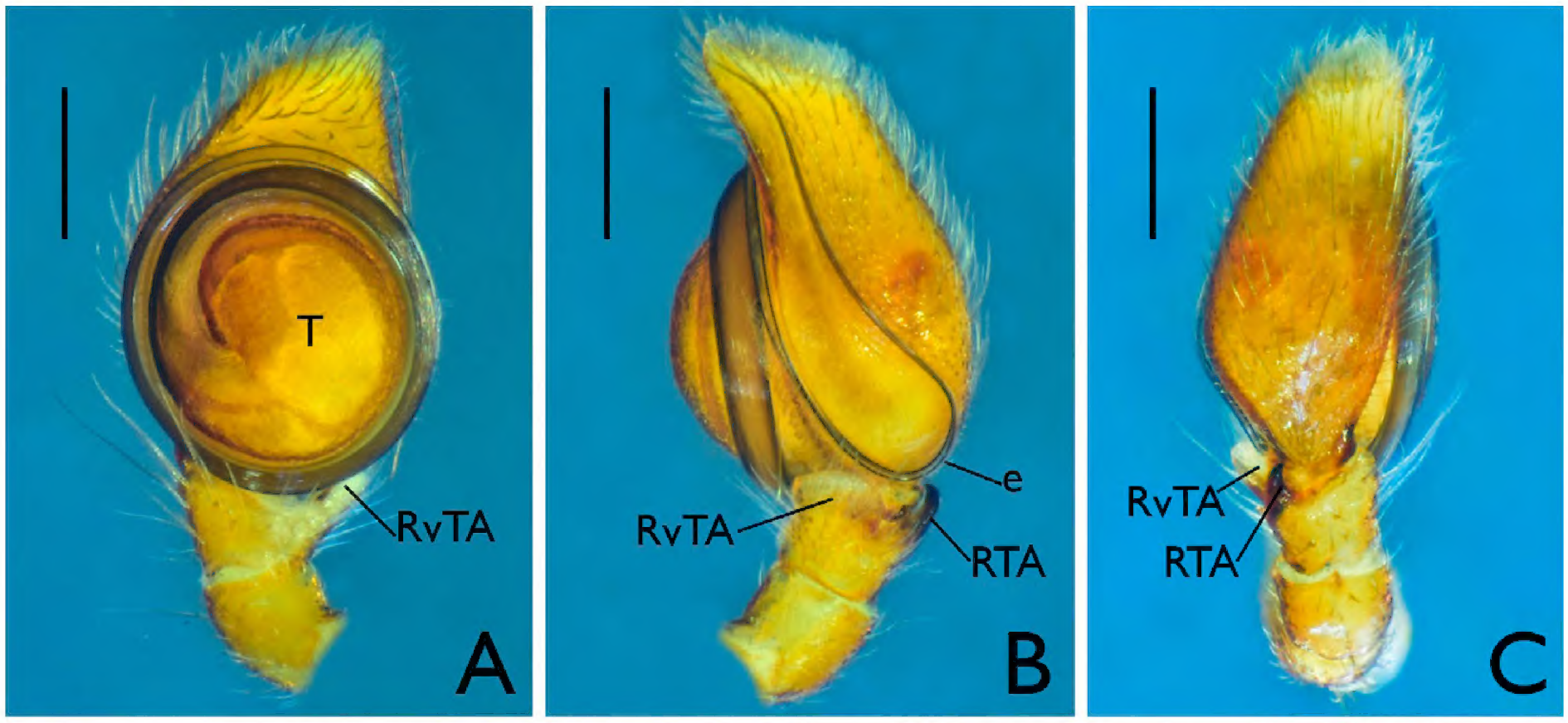

Figure 4. Male and female genitalia of *Gypogyna forceps*. **A–C.** Male palp: (**A**) ventral view; (**B**) retrolateral view; (**C**) prolateral view. **D, E.** Epigyne: (**D**) ventral view; (**E**) dorsal view. Abbreviations: cd = copulatory duct; co = copulatory opening; e = embolus; fd = fertilization duct; RTA = retrolateral tibial apophysis; RvTA = retroventral tibial apophysis; sp = spermatheca; T = tegulum. Scale bars: A–C = 0.25 mm; D–E = 0.2 mm.

Table 1. Comparison between the measurements of *Gypogyna forceps* presented in this study and those reported previously by other authors. In the present study two males and ten females were measured.

Reference	Sex	Body length (mm)	Prosoma length (mm)	Opisthosoma length (mm)	Chelicerae length (mm)	Leg I length (mm)	Leg II length (mm)	Leg III length (mm)	Leg IV length (mm)
Simon 1900	Male	4.6	—	—	—	—	—	—	—
Galiano 1958	Male	3.4	1.5	—	1.1	3.2	2.4	2.5	3.1
	Female	3.8	1.7	—	—	3.1	2.3	2.5	3.3
Bedoya-Róqueme et al. 2019	Male	4.8	2.1	2.7	—	—	—	—	—
Present study	Male	2.9–4.2	1.4–1.9	1.5–2.3	1.0–1.8	3.3–4.5	2.6–3.5	2.7–3.5	3.1–3.7
	Female	3.7–5.2	1.6–1.9	2.1–3.3	0.4–0.6	3.1–3.6	2.6–3.1	2.6–3.0	3.4–3.8

14 (Hagopián et al. 2018). This also constitutes the southernmost record for the species, the nearest one being in Entre Ríos, Argentina (Roget 2017), 72 km to the north along the Uruguay River. However, given the proximity of these two records and the fact that both are in the vicinity of this river, it seems very likely that *G. forceps* could also be found further south along the river coast and adjacent riparian forests in either Argentina, or in Uruguay, where it could occur in the western regions of Soriano and Colonia departments. Likewise, *G. forceps* is also probably present north along the Uruguay River in the Uruguayan departments Paysandú, Salto, and Artigas, in which the Uruguay River and its associated riparian forests seem to act as a biological corridor enabling several subtropical species to expand their distribution ranges southward into more temperate climates

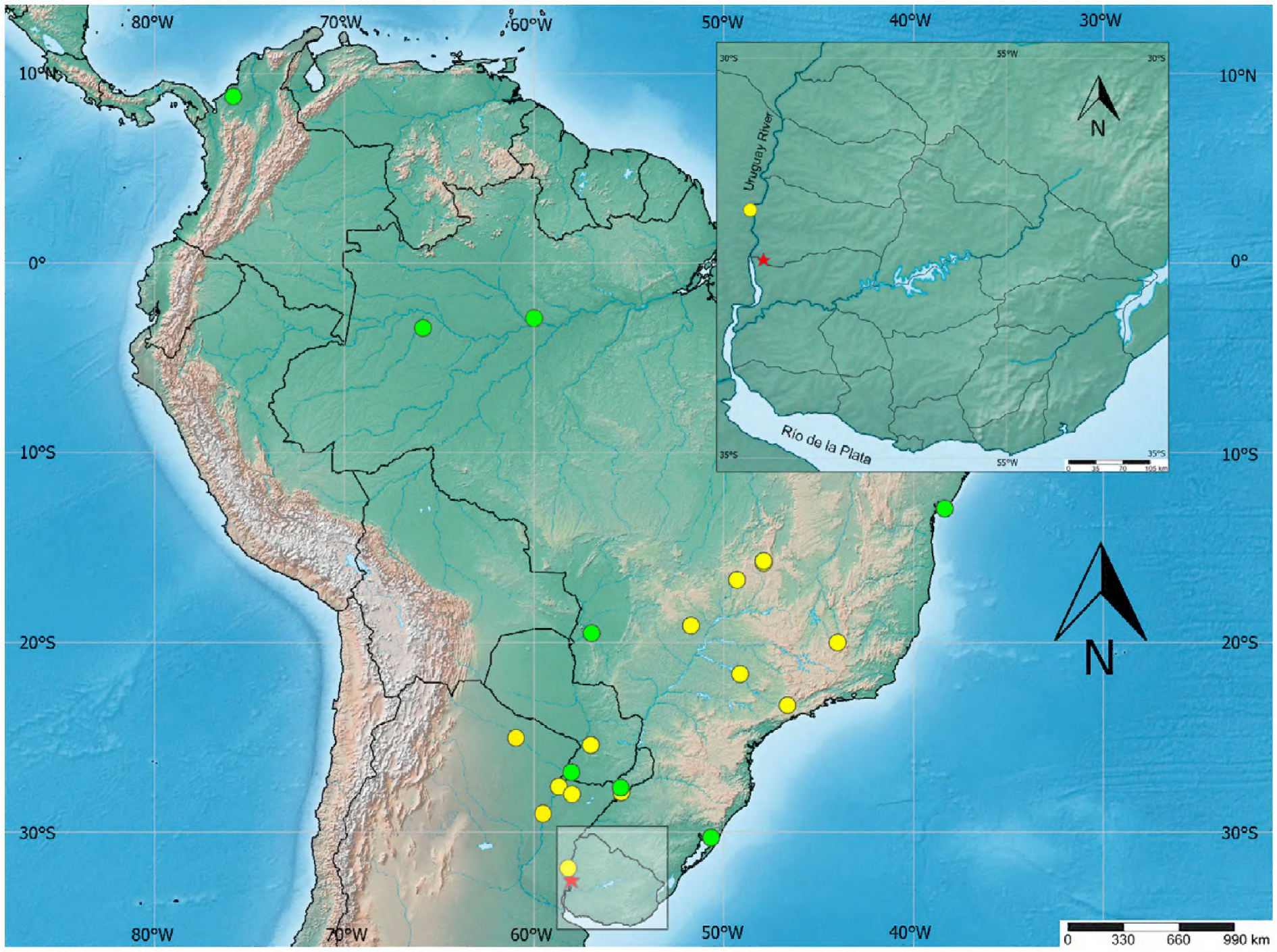

Figure 5. Known distribution of *Gypogyna forceps*. Green circles: records from literature; yellow circles: records from GBIF and iNaturalist; red star: new record from Uruguay.

(Nores et al. 2005; Laborda et al. 2018). Examples of this include bird and plant species (Nores et al. 2005), but also spiders from several families such as *Mesabolivar uruguayensis* Machado, Laborda, Simó & Brescovit, 2013 (Pholcidae) (Laborda et al. 2018; Apodaca et al. 2019), *Deinopis amica* Schiapelli & Gerschman, 1957 (Deinopidae) (Laborda et al. 2012), and *Ancylometes concolor* (Perty, 1833) (Ctenidae) (Laborda et al. 2018), among others. Thus, it seems that *G. forceps* may follow a similar pattern with a continuous distribution along the Uruguay River, being its mouth into the Río de la Plata the southern limit of the species'—and possibly tribe's—geographic range.

The distribution of *Scopocira histrio* Simon, 1900 greatly resembles that of *G. forceps*, with multiple existing collections from Misiones, Argentina, adjacent to the Uruguay River (Costa and Ruiz 2014: fig. 187). Therefore, and given its close relationship with *Gypogyna*, it is possible that it has also dispersed southwards along the Uruguay River corridor, and further sampling of adjacent riparian forests might reveal its presence in Uruguay and Entre Ríos.

Within the GBIF dataset from the Museo Argentino de Ciencias Naturales Bernardino Rivadavia (Ramírez and Rodríguez 2021), there are four records of *G. forceps* from Santa María in the Buenos Aires province, Argentina (37°33′27″S, 061°52′30″W), 665 km southwest from what we report here. However, Galiano (1958) clearly stated that these same specimens (MACN-Ar 4892, 4957, 4958, 4959) were all collected in Santa María in the Misiones province (27°56′00″S, 055°24′27″W), and therefore the assignment of these records to Buenos Aires was due to an erroneous interpretation of the locality. Queries to the museum have confirmed that this is indeed the case (Piacentini pers. com. 2021). The same argument applies to specimens MACN-Ar 4900 and 5690 which belong to *Scopocira histrio*.

Among the observed size variation between specimens, perhaps the most visually striking and intriguing is that of male chelicerae. Enlarged chelicerae in male spiders are frequently associated with intrasexual competition (Jackson 1982; Walker and Holwell 2018). In particular, having disproportionately enlarged chelicerae relative to the rest of the body (i.e., positive allometry) is suggestive of positive selection towards this trait and that it likely represents a selective advantage in some manner (Faber 1983). Indeed, chelicerae size was determined to be a good predictor of success in male contests in *Lyssomanes viridis* (Walckenaer, 1837) (Tedore and Johnsen 2012). Faber and Baylis (1993) also noted that males of *Zygoballus rufipes* Peckham & Peckham, 1885 with longer chelicerae may appear larger to their opponents

than they actually are, dissuading them from escalating encounters to grappling. We believe this kind of intraspecific interactions likely occur in *G. forceps*; however, the lack of behavioral and morphological data—only one previous reference exists for male chelicerae length (Table 1)—does not allow for much beyond speculation at this point. We carried out some cursory behavioral tests by placing males together as well as pairing males with females, but unfortunately were not able to observe any significant interactions as in all cases they simply ignored each other. Therefore, confirmation that males of this species employ their chelicerae as weapons to compete with one another is still needed, as well as whether enlarged chelicerae play a role in courtship displays. Elongated chelicerae could also affect feeding and mating, as seen in other jumping spiders that share this trait (Jackson 1982; Pollard 1994).

There was one particular behavior we were able to observe, however. When walking, both males and females raise legs I and wave them in the air continuously (Supplementary file 1), which is noteworthy given the phylogenetic context of tribe Scopocirini. Ruiz and Maddison (2015) determined on the basis of molecular evidence that Scopocirini forms a clade—"node 2"—with tribes Sarindini and Thiodinini. Sarindini is composed of ant-mimicking species that through ant-like shapes and behaviors attempt to avoid predation (i.e., Batesian mimicry) (Hagopián et al. 2021). A crucial part of this behavioral disguise consists in raising and moving legs I in order to simulate antennae and confuse potential predators. This same behavior was seen by Bustamante and Ruiz (2017) in tribe Thiodinini, both for ant-mimics as well as species with a "typical salticid form". The consistent presence of this behavior in all three tribes of this clade within Amycoida, even in non-ant-mimicking species like *G. forceps*, is noteworthy and certainly deserving of further studies as it could be a valuable source of insight into the evolution of mimicry within this group.

The iNaturalist online platform allows citizens to upload observations of organisms and contribute to the generation of scientific knowledge including, but not limited to, data on species' distribution. While arthropods in general cannot be reliably identified to species level without the use of magnifying equipment to look at genitalia, for instance, *G. forceps* is an exception. Its external appearance is distinctive enough that it allows it to be easily identified with just one photograph of the whole specimen, which enables us to use data from iNaturalist with confidence. Over half of the records presented in this study (Fig. 5) are derived from iNaturalist, and currently some of these are the only existing published records of *G. forceps* for nine states or provinces from Argentina (Chaco, Entre Ríos, Santa Fé), Brazil (Distrito Federal, Goiás, Mato Grosso do Sul, Minas Gerais, São Paulo), and Paraguay (Cordillera). The site has seen a steady increase in usage in recent years (iNaturalist 2020), and this is reflected in the fact that 20 out of 23 records of *G. forceps* currently on the site have been uploaded since early 2020. This points towards iNaturalist becoming a valuable source of information for biodiversity in general in the near future, helping to expand known distribution ranges (Jones et al. 2019; Silva et al. 2021) and aiding in conservation efforts (Wilson et al. 2020), or even the description of new genera and species (Alvarado-Cárdenas et al. 2020; Winterton 2020; Collins and Velazco-Macias 2021).

Future studies will focus on sampling other riparian forests along the Uruguay River to the north and south of Río Negro to assess whether *G. forceps* truly has a continuous distribution along this river and to better document its distribution within Uruguay, and to gather more data on size variation within populations, especially focused on males and male chelicerae. Beyond that, behavioral experiments could be carried out with an aim to better understand the role elongated male chelicerae may play during courtship and/or competition with other males, as well as how they may affect feeding and mating.

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Supplemental Data

Supplementary file 1. Video of a female *Gypogyna forceps* walking and waving the first pair of legs.